

increase of pressure, after being forced southward to Kansas and northern Texas.

Although the disturbance traced as number ix formed in the central Mississippi valley, within the barometric trough which separated the area of high pressure to the north and that which extended over the south Atlantic coast, heavy rains occurred over the states in the Ohio, Mississippi, and lower Missouri valleys during the 23d and 24th. This area of low pressure moved northward to southern Michigan, where it disappeared, by an increase of pressure, on the 25th.

X.—The tri-daily weather charts of the 25th exhibited an extensive area of low pressure covering the central and southern plateau regions and extending southeastward to Texas, and from this region a barometric trough extended northeast-

ward to the Lake region. The most decided cold wave of the month was moving rapidly southward over the Rocky Mountain stations and the Missouri Valley, and the cold air from this area of high pressure apparently replaced the area of low pressure to the westward, and the barometric trough to the eastward was followed by an elliptical area of low pressure extending from Arkansas to northern Michigan, and this was followed by a normal area of low pressure over the Saint Lawrence Valley, which disappeared on the 28th to the east of the stations of observation.

The snow and rain attending this disturbance was apparently caused by sudden changes of temperature due to the advance of a cold wave, the range of temperature amounting to from 40° to 50°.

NORTH ATLANTIC STORMS FOR NOVEMBER, 1887.

[Pressure in inches and millimetres; wind-force by Beaufort scale.]

The paths of the depressions that have appeared over the north Atlantic Ocean during the month are determined from international simultaneous observations furnished by captains of ocean steamships and sailing vessels; reports received through the co-operation of the "New York Herald Weather Service," and the Hydrographic Office, U. S. Navy; and from other miscellaneous data received to December 21, 1887.

Fourteen depressions are traced, of which two are continuations of storms charted for October, 1887; three traversed the ocean from coast to coast; one first appeared east of the fifteenth meridian; five passed eastward over, or to the northward of, Newfoundland; one apparently originated south of Nova Scotia, and three are given probable paths northward from the sub-tropical region. The general direction of movement of the depressions was east-northeast, and their tracks were rather evenly distributed along, and north of, the trans-Atlantic routes. The first decade of the month was characterized by severe weather over the entire ocean north of the fortieth parallel. During the second decade stormy weather continued to the westward of the thirtieth meridian until the 16th; after which the passage of two areas of low pressure southeastward over the British Isles was accompanied by unsettled meteorological conditions until the 22d. From the 10th to the 12th, inclusive, a depression advanced northeastward in the vicinity of the Azores. During the third decade of the month the barometer rose slowly over the British Isles from the 22d to the 24th, after which storms of moderate force prevailed until the 30th, when the barometer rose rapidly, with light to fresh westerly winds and fair weather; over the ocean west of the thirtieth meridian settled weather and high pressure prevailed in the trans-Atlantic routes, except from the 23d to the 25th, inclusive, while to the southward of the thirtieth parallel two depressions appeared on the 29th and 30th.

In November, 1886, twelve depressions were traced, the tracks predominating east of the forty-fifth meridian, with a general north of east direction of movement. The general character of the weather over the north Atlantic was exceedingly severe, and terrific westerly gales, with tremendous seas, were reported during the first half of the month. Violent storms, occasioned by barometric depressions which passed over the eastern portion of the United States without advancing beyond the coast line, were experienced in the Maritime Provinces and over the ocean west of the sixtieth meridian. The first, and a portion of the second, decades of the month were marked by storms of great violence over the British Isles and adjacent waters. For the first decade five depressions were traced; for the second, three, and for the third, four.

In November, 1887, the month opened with low barometric pressure and gales over the entire ocean, except in the vicinity of the Azores, where the barometer ranged high. Over the eastern portion of the ocean the weather was particularly severe, the British Isles and the west-central European coast being swept by hurricanes, causing great loss of life and de-

struction of property. Along the middle Atlantic and New England coasts, and over the Canadian Maritime Provinces, heavy northerly gales prevailed on the 1st, during which many sailing vessels were damaged or driven ashore. From the 1st to the 5th, inclusive, heavy gales continued east of the fortieth meridian, with barometric minima ranging below 29.00 (736.6). From the 6th to the 14th the weather was comparatively settled over the British Isles, while in the vicinity of Newfoundland there was a succession of gales of moderate strength. During this period the barometric pressure in the vicinity of the Azores was generally low and fluctuating. From the 15th to the 21st the passage of depressions northeastward along the middle Atlantic and New England coasts caused unsettled weather south of Nova Scotia and Newfoundland; over mid-ocean the pressure continued high; over the British Isles the barometer fell rapidly during the 17th, and continued low until the 22d, attending the passage of two areas of low pressure. During the last ten days of the month high barometer and fair weather prevailed along the American coast south of the fiftieth parallel; over the ocean east of Newfoundland fair weather and rising barometer followed the passage of a depression which advanced to the northward of the British Isles during the 27th. No storms appeared in the tropical or sub-tropical regions until the last two days of the month, when the presence of depressions, one to the northward of the West Indies and the other to the southwestward of the Azores, was indicated.

The following are descriptions of the depressions traced:

1.—This depression was a continuation of ocean storm number 16 traced for October, 1887, and, as an apparent subsidiary development to depression number 14 charted for that month, closely followed the latter in its passage over the British Isles. At 12 noon on the 1st this storm was central west of Ireland, with barometric pressure below 28.40 (721.3). By the 2d it had apparently moved eastward over the North Sea beyond the region of observation. The disturbances attending this depression caused an immense amount of damage to property, and many lives were lost by the foundering or going ashore of vessels. The following reports indicate the character of weather encountered off the coasts of the British Isles: Capt. G. Franck, of the s. s. "Australia," reports a hurricane on the 1st; wind veered from se. on October 31st to nw. during November 1st; lowest barometer, 28.38 (720.8), at 2 a. m. of the 1st, in N. 49° 47', W. 8° 45'. Capt. W. A. Beynon, of the s. s. "Belgenland," reports a westerly storm on October 31st and November 1st; lowest barometer, 28.32 (719.3), at 1.30 a. m. of the 1st, in N. 50° 15', W. 10° 12'. The storm was marked by squalls of hurricane force.

2.—This depression was a continuation of ocean storm number 15 charted for October, 1887, and is traced from off the American coast, in N. 37°, on the 1st, to the French coast by the 6th. The depression increased in energy until the 5th, when central west of Ireland, after which it moved east-south-

east into France, with a slight increase in barometric pressure. The following reports show the character of the disturbances which attended its passage: "Provincetown, Mass., Nov. 1.—The heaviest 'norther' of the season has been blowing along Cape Cod to-day, the wind reaching a velocity of sixty miles per hour." Capt. Vogelgesang, of the s. s. "Rhaetia," reports a storm from the 2d to the 5th; wind veered from ssw. to ne.; lowest barometer, 28.64 (727.4), at 4 p. m. of the 3d, in N. 49° 43', W. 50° 56'. The s. s. "Egypt" encountered a ssw. to nw. storm during the 4th and 5th; lowest barometer, 29.19 (741.4), at 4 p. m. of the 4th, in N. 50° 36', W. 27° 10'. Capt. G. Franck, of the s. s. "Australia," reports a storm on the 5th and 6th; wind veered from s. to n.; lowest barometer, 29.23 (742.4), at 3 a. m. of the 5th, in N. 49° 30', W. 17° 20'.

3.—This depression appeared northeast of Newfoundland on the 1st, and moved rapidly east-northeast to the vicinity of the Hebrides Islands by the 3d; remaining nearly stationary over the northern portion of the British Isles during the following two dates, the storm-centre apparently passed southward after the 5th and united with depression number 2. This storm possessed great energy throughout, and barometric pressure below 29.00 (736.6) was shown from the 2d to the 4th, inclusive. The following reports have been made relative to disturbances encountered during its passage:

Captain Sargent, of the s. s. "Ohio," reports a westerly storm during October 31st and November 1st; lowest barometer, 29.48 (748.8), at 9.27 a. m. of the 1st, in N. 48° 35', W. 42° 20'. Captain Boggs, of the s. s. "Indiana," reports a strong sw. to nw. gale from October 31st to November 2d; lowest barometer, 29.42 (747.3), at 4 p. m. of the 1st, in N. 47° 0', W. 41° 0'. Captain Sumner, of the s. s. "Egypt," reports a hurricane on the 2d and 3d; wind veered from sw. to nw. by w.; lowest barometer, 28.82 (732.0), at 3 a. m. of the 3d, in N. 50° 40', W. 21° 45'. The s. s. "Australia" experienced a whole w. to nw. gale on the 3d and 4th; lowest barometer, 28.67 (728.2), at noon of the 3d, in N. 49° 42', W. 12° 30'. Capt. H. Walker, of the s. s. "Cephalonia," reports a whole gale from the 1st to the 3d; wind veered from sw. to nw.; lowest barometer, 29.19 (741.4), at 5.45 a. m., in N. 50° 02', W. 26° 52'. The s. s. "Vaderland" encountered a northwest storm on the 2d and 3d; lowest barometer, 29.30 (744.2), at 1 p. m. of the 2d, in N. 50° 19', W. 29° 00'.

4.—This depression apparently originated over the ocean south of Nova Scotia or Newfoundland as a subsidiary development to number 5, with which it had united by the 7th.

5.—This depression was a continuation of an area of low pressure which passed northeast from the Saint Lawrence Valley during the 5th; by the 6th the centre of depression had passed east from the Labrador coast, and by the 7th had moved southeast to the fiftieth parallel; advancing eastward to the thirtieth meridian by the 8th, the depression recurved northward under the influence of an area of high barometric pressure overlying the British Isles and the ocean to the westward; subsequent to the 9th the storm apparently moved westward and united with depression number 6. The following reports refer to this depression: Mr. John Higgins, observer at Saint John's, N. F., reports a southwest gale, with rain, during the night of the 5-6th. During the passage of depression number 4 to the southward of Newfoundland, the s. s. "Sidonian," Captain Jamieson, commanding, encountered a whole sw. to nw. gale, with squalls of hurricane force; lowest barometer, 29.46 (748.3), at noon of the 6th, in N. 42° 12', W. 59° 20'.

6.—This depression moved eastward over the Gulf of Saint Lawrence and northern Newfoundland during the 8th, and on the morning of the 9th was central northeast of Newfoundland, whence it passed slowly northeast and disappeared beyond observation after the 10th, without evidence of marked energy.

7.—This depression first appeared within the region of observation on the 10th, and is given a probable northeast track over the Azores by the 12th, after which its course cannot be determined, owing to an absence of reports; the presence of an area of low barometric pressure between the Azores and the

Portuguese coast was, however, indicated until after the 15th. The storm possessed considerable strength, as is shown by the following reports: Captain James, of the s. s. "Pawnee," reports a strong gale on the 10th and 11th; wind backed from s. to se. and nne.; lowest barometer, 29.37 (746.0), at noon of the 10th, in N. 36° 52', W. 36° 20'. Captain Brown, of the s. s. "Pontiac," reports a strong gale on the 11th; wind veered from sse. to nnw.; lowest barometer, 29.50 (749.7), at 1 p. m., in N. 35° 30', W. 29° 00'.

8.—This depression passed southeast from Nova Scotia, and during the 12th and 13th was central off the southern edge of the Banks of Newfoundland; by the 14th the storm-centre had moved northward and united with depression number 9. The following report shows the character of the weather which prevailed during the storm's passage to the southward of the Banks: Capt. A. de Mugica, of the s. s. "Hugo," reports a strong gale on the 11th and 12th; wind veered from sse. to ssw.; lowest barometer, 29.34 (745.2), at 3.30 p. m. of the 12th, in N. 43° 44', W. 51° 59'.

9.—This depression passed east over northern Newfoundland during the 13th, and, traversing the ocean, advanced southeast over the British Isles during the 18th and 19th and disappeared beyond the region of marine observations. The depression had moderate strength throughout, the disturbances which accompanied it being more severe during the 17th and 18th.

10.—This depression was a continuation of an area of low pressure which moved northeast along the middle Atlantic and New England coasts during the 15th and 16th; during the 17th and 18th the centre of depression passed north of east over Newfoundland from the Gulf of Saint Lawrence, and, subsequent to the 18th, disappeared over the ocean north of the fiftieth parallel. The following reports indicate the character of the weather which attended the passage of this storm: Captain Topser, of the s. s. "Rhein," reports a strong gale on the 15th and 16th; wind veered from se. to w.; lowest barometer, 29.53 (750.0), at noon of the 15th, in N. 39°, W. 69°. Capt. H. Richter, of the s. s. "Saale," reports a strong gale on the 16th and 17th; wind veered from se. to sw.; lowest barometer, 29.25 (742.9), at 8 p. m. of the 16th, in N. 43°, W. 60°. Capt. A. Potjer, of the s. s. "Schiedam," reports a whole gale on the 16th and 17th; wind veered from se. to sw.; lowest barometer, 29.23 (742.4), at 3 a. m. of the 17th, in N. 44°, W. 56°. Capt. E. H. Freeth, of the s. s. "British Princess," reports a whole gale on the 16th and 17th; wind veered from e. to w.; lowest barometer, 29.37 (746.0), at 6.30 a. m. of the 17th, in N. 45° W. 53°.

11.—This depression appeared northwest of Ireland on the 20th, and during that and the succeeding date moved southeast to the French coast, accompanied by fresh to strong gales.

12.—This depression passed eastward from the Labrador coast and was central on the 24th in about N. 54°, W. 41°, whence it advanced to the north of Ireland by the 26th, and subsequently moved northeast beyond the region of observation. The storm exhibited moderate strength and was unattended by noteworthy features.

13.—The path of this depression is approximately located to the northward of the West Indies on the 29th and 30th, a scarcity of reports from that region rendering an accurate location of its centre on those dates impracticable. The following reports show that this depression possessed considerable energy: Captain Evans, of the s. s. "Claribel," reports: "28th, passed Fortune Island, with wind increasing to heavy gale, high sea, and frequent rain squalls. Gale continued from northward and westward, blowing with hurricane force at times until the 29th, in N. 24°, W. 74°, at noon, when wind shifted into ne., with very heavy cross-sea. 30th, in N. 26°, W. 74°, at noon, no abatement in either wind or sea, the latter being more to the northward, with heavy rain and wind squalls; towards midnight encountered three distinct seas, running from n., ne., and nw., those from the n. and ne. being dangerously high." Captain Schütte, of the ship "Fidelio," reports a strong n. by e. gale on the 30th; barometer lowest at 11 p. m., when in N. 35°, W. 68°.

14.—The presence of this depression to the southwest of the Azores during the 29th and 30th was indicated by scattering reports, which, while they allowed of approximately locating its centre and path on those dates and showed that severe weather prevailed, were not sufficiently numerous to admit of determining its probable path previous to the 29th.

OCEAN ICE.

No ice was reported during the month.

In November, 1886, the only ice reported was a berg from fifty to sixty feet high observed on the 2d, in N. 45° 20', W. 45° 26', from the s. s. "Elstow."

In November, 1885, the only iceberg reported was observed in N. 48° 00', W. 51° 10'. In November, 1884, several icebergs were seen in N. 45° 56', W. 52° 38'. For the corresponding month of 1883 and 1882 no ice was reported.

FOG.

The limits of fog-belts to the westward of the fortieth meridian are shown on chart i by dotted shading.

As compared with the chart for the preceding month, October, 1887, slight changes are shown in the eastern and southern limits of fog in the vicinity of the Newfoundland Banks, while to the westward of the sixtieth meridian there has been an increase in the number of fog-areas reported in the trans-Atlantic tracks and along the coast north of the fortieth parallel.

The meteorological conditions which attended the development of fog on the fourteen dates for which it was reported near Newfoundland were as follows: On the 1st an area of low pressure passing to the northward of the Banks was accompanied during the morning by low barometric readings, southerly winds, and fog. During the 3d dense fog attended the passage of a cyclonic area northeastward over the southern edge of the Banks. On the 6th the conditions were unsettled attending the passage of cyclonic areas, one over, and the other to the northward of the Banks; no report of fog on that date has, however, been received. From the 8th to the 10th, inclusive, fog prevailed with the passage of a cyclonic area eastward over the Gulf of Saint Lawrence, Newfoundland, and the ocean north of the Banks. During the 12th, 13th, and 14th, the development of fog attended the presence over the Gulf of Saint Lawrence and northern Newfoundland of low barometer areas. On the 17th a cyclonic area moved northeast over northern Newfoundland, and dense fog prevailed over the Banks. From the 20th to the 24th, inclusive, south to east winds and fog prevailed south and southeast of Newfoundland. During this period an area of low pressure moved northeast

along the New England coast, over the Gulf of Saint Lawrence, and the ocean north of Newfoundland. Subsequent to the 24th no cyclonic areas appeared near Newfoundland, and no fog was reported.

On the 20th, 27th, and 28th fog was reported off the south coasts of Nova Scotia and Cape Breton Islands. On the first-mentioned date, south to southeast winds prevailed in that region with the presence on the New England coast of an area of low barometer, while during the 27th and 28th the winds were from the southeast quadrant and anti-cyclonic.

During the 25th, 26th, and 27th fog was reported north of the fortieth parallel and west of the sixty-fifth meridian, the winds during that period being generally from south to east and anti-cyclonic.

The following are the limits of fog-areas on the north Atlantic Ocean during November, 1887, as reported by shipmasters:

Date.	Vessel.	Entered.			Cleared.		
		Lat. N.	Lon. W.	Time.	Lat. N.	Lon. W.	Time.
1	S. S. Swansea	48 35	46 05	7 p. m.	45 00	47 30	5.20 p. m.
3	S. S. Caspian	48 35	46 05	7 p. m.	48 18	47 25	Midnight.
8	Fog at Saint John's, N. F.						
9	S. S. Egypt	46 45	47 00		46 15	48 30	
9-10	S. S. City of Richmond	47 49	42 49		48 03	41 51	
12	S. S. Rhein	43 28	51 00	10 a. m.	43 04	52 13	3.30 p. m.
12-13	S. S. Barrowmore	46 00	49 32	11.30 p. m.	45 26	51 08	8 a. m.
13-14	S. S. Marsala	46 22	46 43	11.34 a. m.	45 29	50 59	6.24 a. m.
13-14	S. S. Waeland	46 44	45 48		45 13	50 10	
14	S. S. Rugia	44 40	51 31	1 a. m.	44 49	50 47	3 a. m.
17	S. S. Hermann	46 43	46 18		46 30	47 40	
20	S. S. Caspian	46 15	48 43		46 02	49 49	
20	S. S. Dorian	44 20	63 40	1 a. m.			6 p. m.
20	S. S. Surrey	41 31	47 50		41 33	48 15	
20	S. S. Scandinavian	48 51	45 01		43 36	47 51	
20	S. S. Polynesia	44 47	52 57	6 a. m.	44 32	53 51	9.30 a. m.
20	S. S. Noerland	46 20	49 00		46 00	50 00	
20	Fog at Saint John's, N. F.	45 05	52 56		44 45	54 03	
21	Fog at Saint John's, N. F.						
21	S. S. Polynesia	45 35	50 50		45 20	51 30	
21	S. S. Noerland	43 00	60 35		42 50	61 15	At inter-
21	S. S. Cephalonia	47 10	43 43		46 22	45 40	vals.
21-22	S. S. Leerdam	45 58	45 14	8.30 p. m.	45 50	46 32	a. m.
22	Fog at Saint John's, N. F.						
22	S. S. Aurania	44 04	50 06		44 30	48 33	[vals.
22-23	S. S. Cephalonia	45 58	46 45		44 16	52 59	At inter-
22-23	S. S. Strabo	45 00	51 49		47 00	45 00	
23	S. S. Hekla	45 45	50 30		45 00	52 30	
24	do	44 30	55 20		43 50	56 45	
25	S. S. Surrey	40 40	66 40		40 15	68 10	
25-26	S. S. Cephalonia	42 24	69 29		42 20	70 53	
25-27	S. S. Yemassee	40 10	74 00		↑	↑	
26	S. S. Leerdam	40 41	66 20		40 41	66 44	
27-28	S. S. Sarnia	45 42	58 29		44 26	63 22	

• Halifax.

† New York City.

TEMPERATURE OF THE AIR (expressed in degrees, Fahrenheit).

The distribution of mean temperature over the United States and Canada for November, 1887, is exhibited on chart ii by dotted isothermal lines. In the table of miscellaneous data are given the monthly mean temperatures, with the departures from the normal, for the various stations of the Signal Service. The figures opposite the names of the geographical districts in the columns for mean temperature, precipitation, and departures from the normal, show respectively the averages for the several districts. The normal for any district may be found by adding the departure to the current mean for the district when the departure is below the normal, and subtracting when above. On chart iii the daily mean temperatures and departures from the normal are graphically shown for selected stations.

The month of November, 1887, was slightly colder than the average in the following-named sections of the country: along the Atlantic coast south of New England, in the Saint Lawrence Valley, lower lake region, lower Ohio valley, and the eastern part of the upper Mississippi valley. In these districts the departures were less than 1° at a majority of stations. There were but two small areas over which the temperature was as much as 2° below the normal, viz., (1) eastern New York (in the vicinity of Albany) and adjacent portions of Massachusetts and Vermont; and (2) the North Carolina coast in the vicinity

of Wilmington. In the other districts, embracing much the greater part of the United States, the mean temperatures were above the November normal. The region over which the most marked departures above the normal temperature occurred extends from Idaho southeastward to western Texas, the excess of temperature generally ranging from 4° to 7°.

The following are some of the most marked departures from normal temperatures at Signal Service stations:

Above normal.		Below normal.	
	°		°
Salt Lake City, Utah.....	7.7	Wilmington, N. C.....	3.1
Santa Fe, N. Mex.....	6.9	Albany, N. Y.....	2.9
Cheyenne, Wyo.....	5.0	Portland, Me.....	2.3
El Paso, Tex.....	4.2	Key West, Fla.....	2.0
Red Bluff, Cal.....	4.2	Norfolk, Va.....	1.9
Yuma, Ariz.....	4.0	Hatteras, N. C.....	1.8
Fort Sill, Ind. T.....	3.9	Grand Haven, Mich.....	1.8
Fort Grant, Ariz.....	3.6	Savannah, Ga.....	1.6

RANGES OF TEMPERATURE.

The monthly and the greatest and least daily ranges of temperature at Signal Service stations are given in the table of miscellaneous meteorological data. The region in which the monthly ranges were greatest extends from western Kansas and eastern Colorado northward to British America; they generally